

CLAIMS

1. In a method for removing acid gases in a gas, to be scrubbed, containing carbon dioxide by bringing the gas to
5 be scrubbed into contact with a gas scrubbing liquid containing alkaline agent, an acid gas scrubbing method, characterized in that:

10 said gas scrubbing liquid is regenerated by bringing said gas scrubbing liquid into contact with a regenerating gas having components different from said gas to be scrubbed, and the regenerated gas scrubbing liquid is used as a scrubbing liquid of said gas, to be scrubbed, containing carbon dioxide.

2. In a method for removing acid gases in a gas, to
15 be scrubbed, containing carbon dioxide by bringing the gas to be scrubbed into contact with a gas scrubbing liquid containing alkaline agent, an acid gas scrubbing method, characterized in that:

20 said gas scrubbing liquid is regenerated by bringing said gas scrubbing liquid into contact with a regenerating gas having components different from said gas to be scrubbed, and then regenerated by bringing said gas scrubbing liquid into contact with a second regenerating gas having components identical to or different from said regenerating gas, and the
25 regenerated gas scrubbing liquid is used as a scrubbing liquid of said gas, to be scrubbed, containing carbon dioxide.

3. In a method for removing acid gases in a gas, to

be scrubbed, containing strong acid gases such as hydrogen chloride and weak acid gases such as hydrogen sulfide and carbon dioxide by bringing said gas to be scrubbed into contact with a gas scrubbing liquid containing alkaline agent,
5 an acid gas scrubbing method, characterized in that:

said strong acid gases in said gas to be scrubbed are removed by bringing said gas to be scrubbed into contact with a first gas scrubbing liquid containing first alkaline agent, and then said carbon dioxide and said weak acid gases in said
10 gas to be scrubbed are removed by bringing said gas to be scrubbed into contact with a second gas scrubbing liquid containing second alkaline agent, said first gas scrubbing liquid and said second gas scrubbing liquid are regenerated by bringing said first gas scrubbing liquid and said second gas
15 scrubbing liquid into contact with a first regenerating gas and a second regenerating gas, respectively, which have components different from said gas to be scrubbed, and the regenerated first gas scrubbing liquid and the regenerated second gas scrubbing liquid are used as a scrubbing liquid of
20 said gas to be scrubbed.

Sub A' > 4. An acid gas scrubbing method according to any one of claims 1 to 3, wherein said gas to be scrubbed comprises a gas produced by gasification of combustibles in a gasification
25 step.

5. An acid gas scrubbing method according to any one of claims 1 to 4, wherein after said gas to be scrubbed is

scrubbed, the scrubbed gas is supplied to a hydrogen production step.

5 6. An acid gas scrubbing method according to any one of claims 1 to 5, wherein after said gas to be scrubbed is scrubbed, the scrubbed gas is supplied to a fuel cell via a hydrogen production step.

10 7. An acid gas scrubbing method according to any one of claims 1 to 3, wherein said gas to be scrubbed comprises a gas generated by incineration of combustibles.

20 8. An acid gas scrubbing apparatus, comprising:
a gas scrubber for removing acid gases in a gas, to be scrubbed, containing carbon dioxide by bringing the gas to be scrubbed into contact with a gas scrubbing liquid containing alkaline agent;

20 a scrubbing liquid regenerator for regenerating and cooling said gas scrubbing liquid by bringing said gas scrubbing liquid into contact with a regenerating gas having components different from said gas scrubbing liquid and said gas to be scrubbed; and

25 circulating means provided between said gas scrubber and said scrubbing liquid regenerator for circulating said scrubbing liquid.

9. An acid gas scrubbing apparatus, comprising:
a gas scrubber for removing acid gases in a gas, to be

scrubbed, containing carbon dioxide by bringing the gas to be scrubbed into contact with a gas scrubbing liquid containing alkaline agent;

5 a first scrubbing liquid regenerator for regenerating and cooling said gas scrubbing liquid by bringing said gas scrubbing liquid into contact with a first regenerating gas having components different from said gas scrubbing liquid and said gas to be scrubbed;

10 a second scrubbing liquid regenerator for regenerating and cooling said gas scrubbing liquid discharged from said first scrubbing liquid regenerator by bringing said gas scrubbing liquid into contact with a second regenerating gas having components identical to or different from said first regenerating gas; and

15 circulating means provided between said gas scrubber and said second regenerator for circulating said scrubbing liquid.

10. An acid gas scrubbing apparatus, comprising:

20 a gas scrubber for removing acid gases in a gas, to be scrubbed, containing carbon dioxide by bringing the gas to be scrubbed into contact with a gas scrubbing liquid containing alkaline agent;

25 a three-stage or more of scrubbing liquid regenerator for regenerating and cooling said gas scrubbing liquid by bringing said gas scrubbing liquid into contact with plural kinds of regenerating gases having components different from said gas scrubbing liquid and said gas to be scrubbed; and

circulating means provided between a final-stage

regenerator and said gas scrubber for circulating said scrubbing liquid for the purpose of returning said scrubbing liquid from said final-stage regenerator to said gas scrubber.

Sub 8 2 / 11. An acid gas scrubbing apparatus according to claim 8 or 9 or 10, further comprising a gas-liquid separator provided between said gas scrubber and said scrubbing liquid regenerator for separating gas components, to be scrubbed, accompanied by said gas scrubbing liquid;
10 wherein said gas scrubbing liquid flows from said gas scrubber into said gas-liquid separator, and after gas-liquid separation, said gas scrubbing liquid flows in said scrubbing liquid regenerator.

15 12. An acid gas scrubbing apparatus according to any one of claims 8 to 11, wherein as said regenerating gas of said scrubbing liquid, oxygen-containing gas such as air or pure oxygen is used.

20 13. An acid gas scrubbing apparatus according to claim 12, further comprising a gas-liquid separator provided downstream of said scrubbing liquid regenerator in a scrubbing liquid path for separating gas components, to be scrubbed, accompanied by said gas scrubbing liquid;

25 wherein said gas scrubbing liquid flows from said scrubbing liquid regenerator to said gas-liquid separator, and after removing gas components accompanied by said gas scrubbing liquid by gas-liquid separation, said gas scrubbing

liquid flows in a regenerator or a gas scrubber provided downstream of said gas-liquid separator.

Sub A³

14. An acid gas scrubbing apparatus according to any one of claims 8 to 13, wherein a gas-phase pressure in said gas scrubber is operated in the range of 80 to 110 kPa, and a gas-phase pressure in said scrubbing liquid regenerator is operated in the range of 110 to 200 kPa.

15. An acid gas scrubbing apparatus according to any one of claims 8 to 14, wherein a temperature of said circulating scrubbing liquid is in the range of 50 to 300°C.

16. An acid gas scrubbing apparatus according to any one of claims 8 to 14, wherein a temperature of said circulating scrubbing liquid is in the range of 50 to 200°C.

17. An acid gas scrubbing apparatus according to any one of claims 8 to 14, wherein a temperature of said circulating scrubbing liquid is in the range of 50 to 100°C.

18. An acid gas scrubbing apparatus, comprising:
a first gas scrubbing section for removing strong acid gases in a gas, to be scrubbed, containing said strong acid gases such as hydrogen chloride and weak acid gases such as hydrogen sulfide and carbon dioxide and cooling said gas to be scrubbed by bringing said gas to be scrubbed into contact with a first gas scrubbing liquid containing first alkaline agent

in a countercurrent flow;

5 a second gas scrubbing section for removing carbon dioxide and weak acid gases in said gas, to be scrubbed, discharged from said first gas scrubbing section and cooling said gas to be scrubbed by bringing said gas to be scrubbed into contact with a second gas scrubbing liquid containing second alkaline agent in a countercurrent flow;

10 a first scrubbing liquid regenerator for regenerating and cooling said first gas scrubbing liquid by bringing said first gas scrubbing liquid into contact with a first regenerating gas having components different from said first gas scrubbing liquid and said gas to be scrubbed in a countercurrent flow;

15 a second scrubbing liquid regenerator for regenerating and cooling said second gas scrubbing liquid by bringing said second gas scrubbing liquid into contact with a second regenerating gas having components different from said second gas scrubbing liquid and said gas to be scrubbed in a countercurrent flow;

20 circulating means provided between said first gas scrubbing section and said first scrubbing liquid regenerator for circulating said first scrubbing liquid; and

25 circulating means provided between said second gas scrubbing section and said second scrubbing liquid regenerator for circulating said second scrubbing liquid.

19. An acid gas scrubbing apparatus according to claim 18, wherein said circulating means provided between said first

gas scrubbing section and said first scrubbing liquid regenerator for circulating said first scrubbing liquid comprises chemical adding means for adding aqueous solution containing said first alkaline agent, and solid-liquid
5 separation means for separating solid components in said first scrubbing liquid.

Sub A" > 20 An acid gas scrubbing apparatus according to claim 18 or 19, further comprising gas-liquid separators provided
10 between said first gas scrubbing section and said first scrubbing liquid regenerator and between said second gas scrubbing section and said second scrubbing liquid regenerator, respectively, for separating gas components, to be scrubbed, accompanied by said first and second gas scrubbing liquid.

15 21. An acid gas scrubbing apparatus according to any one of claims 18 to 20, wherein as said first regenerating gas, oxygen-containing gas such as air or pure oxygen is used.

20 22. An acid gas scrubbing apparatus according to any one of claims 18 to 21, further comprising gas-liquid separators provided downstream of said first and second scrubbing liquid regenerators in a scrubbing liquid path, respectively, for separating regenerating gas components
25 accompanied by said first and second gas scrubbing liquid.

23. An acid gas scrubbing apparatus according to any one of claims 18 to 22, wherein a gas-phase pressure in said

first and second gas scrubbing sections is operated in the range of 80 to 110 kPa, and a gas-phase pressure in said first and second scrubbing liquid regenerators is operated in the range of 110 to 200 kPa.

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24. An acid gas scrubbing apparatus according to any one of claims 18 to 23, wherein the temperature of said first scrubbing liquid at the outlet of said first gas scrubbing section is in the range of the boiling point to the boiling point minus 20°C, and the temperature of said first scrubbing liquid at the inlet of said first gas scrubbing section is in the range of the temperature of said first scrubbing liquid at the outlet of said first gas scrubbing section to said temperature of said first scrubbing liquid at the outlet of said first gas scrubbing section minus 20°C or in the range of the saturation temperature of steam in the gas to be scrubbed to said saturation temperature of steam minus 5°C.

25. An acid gas scrubbing apparatus according to any one of claims 18 to 24, wherein the temperature of said second scrubbing liquid at the outlet of said second gas scrubbing section is in the range of the temperature of said first scrubbing liquid at the inlet of said first gas scrubbing section to said temperature of said first scrubbing liquid at the inlet of said first gas scrubbing section minus 20°C, and the temperature of said second scrubbing liquid at the inlet of said second gas scrubbing section is lower than the temperature of said second scrubbing liquid at the outlet of said second

gas scrubbing section by 5°C or more.

26. An acid gas scrubbing apparatus according to any one of claims 18 to 25, wherein a pH of said first scrubbing liquid in said first gas scrubbing section is in the range of 4 to 11, and a pH of said second scrubbing liquid in said second gas scrubbing section is in the range of 7 to 12.

27. A gasification system of combustibles, characterized in that:

a gasification apparatus is provided to obtain a combustible gas from combustibles such as combustible wastes, biomass, or coal, a produced gas produced by said gasification apparatus is scrubbed by said acid gas scrubbing method according to any one of claims 1 and 2 or said acid gas scrubbing apparatus according to any one of claims 8 to 17, and a regenerator vent gas of said acid gas scrubbing apparatus is led to said gasification apparatus to be utilized as a gasifying agent for gasification.

28. A gasification system of combustibles, characterized in that:

a gasification apparatus is provided to obtain a combustible gas from combustibles such as combustible wastes, biomass, or coal, a produced gas produced by said gasification apparatus is cooled and scrubbed by said acid gas scrubbing method according to claim 3 or said acid gas scrubbing apparatus according to any one of claims 18 to 26, and a first

scrubbing liquid regenerator vent gas of said acid gas scrubbing apparatus is led to said gasification apparatus to be utilized as a gasifying agent for gasification.

5 29. A gasification system of combustibles according to claim 27 or 28, wherein said gasification apparatus comprises a fluidized-bed gasification furnace whose bed temperature is operated in the range of 450 to 950°C.

10 30. A gasification system of combustibles according to claim 29, wherein said gasification apparatus comprises a melting furnace provided downstream of said fluidized-bed gasification furnace and operated at a temperature of 1200 to 1500°C for melting and slagging dust components contained in
15 the produced gas.

20 31. An incineration system, characterized in that:
an incineration apparatus is provided to incinerate combustibles such as combustible wastes, combustion exhaust gas from said incineration apparatus is scrubbed by said acid gas scrubbing apparatus according to any one of claims 8 to 17, and a regenerating gas of said acid gas scrubbing apparatus is led to said incineration apparatus to be utilized as a combustion oxidization gas.

25 32. An incineration system according to claim 31, wherein said incineration apparatus comprises a fluidized-bed incinerator whose bed temperature is operated in the range of

450 to 950°C.

33. An incineration system according to claim 32,
wherein said incineration apparatus comprises a melting
5 furnace provided downstream of said fluidized-bed incinerator
and operated at a temperature of 1200 to 1500°C for melting
and slagging dust components contained in the combustion gas.

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